WHAT IS CLAIMED IS:

1.   A self aligning torque reference value calculating apparatus comprising:

a self aligning torque estimating portion which estimates a self aligning torque applied to a tire;

a slip angle estimating portion which estimates a slip angle of the tire;

a self aligning torque model value calculating portion which calculates a self aligning torque model value using the slip angle estimated by the slip angle estimating portion;

a self aligning torque ratio calculating portion which calculates a self aligning torque ratio which is a ratio between the self aligning torque estimated by the self aligning torque estimating portion and the self aligning torque model value calculated by the self aligning torque model value calculating portion; and

a self aligning torque reference value calculating portion which calculates a self aligning torque reference value based on the self aligning torque ratio and the self aligning torque model value when a maximum value of the self aligning torque ratio calculated by the self aligning torque ratio calculating portion exceeds a threshold value.

2.   The apparatus according to claim 1, wherein the self aligning torque reference value calculating portion outputs the self aligning torque model value as the self aligning torque reference value when the maximum value of the self aligning torque ratio does not exceed the threshold value.

3.   The apparatus according to claim 1, wherein the self aligning torque reference value calculating portion calculates the self aligning torque reference value by summing the self aligning torque ratio and the self aligning torque model value.

4.   The apparatus according to claim 1 further comprising:

a high pass filter which performs high pass filter processing on the slip angle estimated by the slip angle estimating portion;

a lateral force calculating portion which calculates a lateral force applied to the tire;

a low pass filter which performs low pass filter processing on the slip angle obtained by conversion by the slip angle converting portion; and

5   a summing portion which sums the slip angle on which the high pass filter processing has been performed by the high pass filter and the slip angle on which the low pass filter processing has been performed by the low pass filter, wherein the self aligning torque model value calculating portion calculates the self aligning torque model value based on the slip angle obtained by summation by the

10   summing portion.

        5.   A road surface friction state estimating apparatus comprising:

a self aligning torque estimating portion which estimates a self aligning torque applied to a tire;

15   a slip angle estimating portion which estimates a slip angle of the tire;

a self aligning torque model value calculating portion which calculates a self aligning torque model value using the slip angle estimated by the slip angle estimating portion;

20   a self aligning torque ratio calculating portion which calculates a self aligning torque ratio which is a ratio between the self aligning torque estimated by the self aligning torque estimating portion and the self aligning torque model value calculated by the self aligning torque model value calculating portion;

a self aligning torque reference value calculating portion which

25   calculates a self aligning torque reference value based on the self aligning torque ratio and the self aligning torque model value when a maximum value of the self aligning torque ratio calculated by the self aligning torque ratio calculating portion exceeds a threshold value; and

a road surface friction state estimating portion which estimates a road

30   surface friction state based on the self aligning torque estimated by the self aligning torque estimating portion and the self aligning torque reference value calculated by the self aligning torque reference value calculating portion.

6.   The apparatus according to claim 5, wherein the road surface friction state estimating portion estimates a grip degree of the tire as the road surface friction state, based on a ratio between the self aligning torque and the self aligning torque reference value.

7.   The apparatus according to claim 6, wherein the road surface friction state estimating portion estimates a road surface friction coefficient based on the grip degree and a lateral acceleration.

8.   A self aligning torque reference value calculating method comprising the steps of:

estimating self aligning torque applied to a tire;

estimating a slip angle of the tire;

calculating a self aligning torque model value using the estimated slip angle;

calculating a self aligning torque ratio which is a ratio between the estimated self aligning torque and the calculated self aligning torque model value; and

calculating a self aligning torque reference value based on the self aligning torque ratio and the self aligning torque model value when a maximum value of the calculated self aligning torque ratio exceeds a threshold value.

9.   A road surface friction state estimating method comprising:

estimating a self aligning torque applied to a tire;

estimating a slip angle of the tire;

calculating a self aligning torque model value using the slip angle estimated;

calculating a self aligning torque ratio which is a ratio between the self aligning torque estimated and the self aligning torque model value calculated;

calculating a self aligning torque reference value based on the self aligning torque ratio and the self aligning torque model value when a maximum value of the self aligning torque ratio calculated exceeds a threshold value; and

estimating a road surface friction state based on the self aligning torque estimated and the self aligning torque reference value calculated.